on the inheritance of acquired conditions in the higher animals in which it is claimed that, notwithstanding Weismann to the contrary, there is distinct evidence of the inheritance of such conditions. This evidence is found in Stockard's experiments of breeding from alcoholized guinea-pigs. Here we are confronted by the resurrection of a time-worn discussion, which had its origin, to a large extent, in a failure to understand the meaning attached by Weismann and biologists in general to the terms "congenital" and "acquired." A congenital variation is for them one directly due to a modification of the constitution of the germ cell, while one that was acquired had its origin independently of the germ cell and could be supposed to affect it only secondarily and indefinitely, if at all. Stockard's cases are manifestly examples of a direct intoxication of the germ cells, whereby these were impaired, the impairment being passed on through successive generations, just as changes due to the environment may be transmitted through several generations of bacteria. These cases do not therefore bear on the question of the inheritance of acquired variations, using that expression in the Weismannian sense, but they do show most admirably the cumulative effects resulting from the conjugation in successive generations of vitiated germ cells.

Dr. Adami does not, however, direct all his energies towards the discomfiture of biologists. In the concluding chapters of the lectures he assumes a constructive rôle and outlines a theory of variation and differentiation which is worthy of serious consideration. It assumes as the structural units of the cell the complex protein molecules, each with numerous lightly linked side-chains and capable, therefore, of ready modification under changed conditions. The details of the theory can not be discussed here and those interested must be referred to the lectures and other contributions in which Professor Adami elaborates them, considering in a suggestive manner the phenomena of enzyme and hormone action and of immunity in the light of this chemico-physical hypothesis. The theory can not yet be taken as more than a suggestion, but if it can serve to diagrammatize for us other complicated phenomena as clearly as it has those of fertilization at the hands of Lillie it will become a useful working hypothesis.

The second part of the book consists for the most part of earlier articles and addresses containing the substance of the ideas that have been worked up into the Croonian Lectures, but to these some additional chapters are added, one for instance on the myelins and potential fluid crystalline bodies of the organism, another on the dominance of the nucleus (both reprints of lectures delivered twelve years ago) and another on adaptation and inflammation. The third and concluding section of the volume is entitled "Growth and Overgrowth" and is a collection of addresses and articles dealing with the causation, characteristics and classification of tumors.

J. P. McM.

SPECIAL ARTICLES

STYLONICHIA IMPALED UPON A FUNGAL FILAMENT

The following observations of the curious result of the overzealous feeding activities of a protozoon were made during July, 1918, while the writer was giving the summer session courses in zoology at the State University of New Jersey and Rutgers Scientific School. The material which furnished the organisms here described was obtained from the spray filter bed of a sewage disposal plant near Dunellen, New Jersey. The particular sample of this material in which the organisms were observed had stood over night in a test-tube and, for examination, a small amount was transferred with a pipette from the surface of the fluid in the test-tube to an ordinary microscopic slide. At the first glance through the microscope the material was seen to be swarming with *Stylonichia*, propably *S. vorax* Stokes. Upon moving the slide about, a mass of zoogloeal material was observed and from it some slender branching filaments were projecting into the surrounding fluid.

It was upon these branching filaments that the writer was astonished to see numerous struggling *Stylonichia* impaled, with the filaments passing through their bodies. Not the least astonishing was the fact that many of the animals were located at points basal to branches of the filaments, indicating that they had been held prisoner for some time.

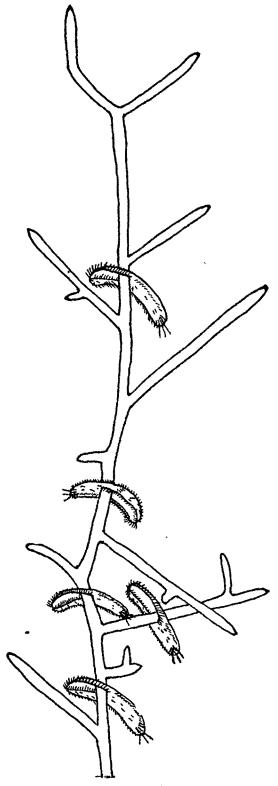

FIG. 1.

The accompanying sketch (Fig. 1), drawn free hand at the time, indicates fairly accurately the conditions on one filament. A number of other filaments were observed to be similarly decorated. From the illustration it will be seen that, beyond the protozoon most proximally placed on the filament, nine branches had arisen and beyond the most distal of the ciliates two branches had formed. Further, it will be observed that the animals invariably had their oral, or ventral, surfaces turned toward the base of the filament and that the filament passed through the oral aperture, or cytostome.

Two ideas are suggested by these conditions; first, that the *Stylonichia* may have become impaled as a result of efforts to swallow the tip of the growing filament, and second that the growth of the filament was comparatively rapid. Subsequent observations confirmed these impressions.

During the two hours following the discovery of the impaled animals some eight or ten individuals were seen to make the attempt to swallow the tip of one or another of the branches of the filaments. *Stylonichia* are known to be energetic feeders and, according to Stokes, this particular species is especially voracious, hence its specific name, *vorax*. In the observed instances the tip of a filament would be taken in until its extremity was near the posterior end of the animal. After a short time spent in the hopeless effort to devour the filament the ciliate would make an attempt to back away and divest itself of the unaccommodating object. In every case of this kind it appeared that the tip of the filament adhered somewhat to the protoplasm of the protozoon, thus interfering greatly with its effort to release itself. There ensued therefore a struggle upon the part of *Stylonichia* which, while possibly not describable as "frantic," nevertheless gave evidence of taxing the powers of the animal to the utmost; and it gave rise to reactions which were decidedly opposed to the success of the object to be attained. To adopt anthropomorphic phraseology one might say that the animal, becoming desperate, seized upon anything at hand in an effort to pull itself away from the now offending "thorn in its flesh." The most convenient and in fact usually the sole object offering such a possible means of escape was the filament itself. Consequently the animal clung to the filament with its strong ventral cirri and endeavored in this way to pull itself away from the tip. The result was to pull itself still further on to the filament and thus to cause the tip to be thrust further into the protoplasm and even—as shown by

the impaled individuals—through the cortex to the outside.

While no animals were observed actually to thrust the filament through their bodies in this way, in several cases they were seen to be pulling with force sufficient to cause a distinct papilla-like elevation on the outer surface and it was easy to see how a slightly stronger pull would have caused the tip to penetrate the cortex, thus impaling the struggling creatures.

In every case of attempted ingestion observed, however, the animals sooner or later abandoned the effort to escape by "climbing" the filament itself; then by turning one way and another, even whirling about the tip at times, they were able eventually to disengage themselves. Had they pulled on the filament while the tip was in the region of the thin cortex at the contractile vacuole, it is probable that penetration would have taken place more readily.

By their efforts to free themselves after becoming impaled the ciliates frequently produced great holes through their bodies much larger than the diameter of the filament. It seemed therefore that they might possibly have escaped by enlarging these holes through constant pushing and pulling until a rupture was produced at one side. None of them were observed to escape in this way although in some only a relatively narrow strip of cortex prevented.

One instance was noted, when the observations began, in which an individual was impaled with its aboral or dorsal side toward the base of the filament. It was near the end of a branch and by pulling on the part of the branch distal to it the animal was soon enabled to reach the end and escape. This exception to the rule can best be accounted for by supposing that the individual was accidentally stabbed through during the transfer to the slide with the pipette. In all the other cases observed, as noted above, the oral sides of the animals were toward the base of the filament.

As to the filament, its fungoid nature was indicated by the entire absence of color. It appeared to be far more rigid than most of the zoogloeal specimens and in fact its rigidity is attested by its effect on the protoplasm of its would-be devourer. The growing tips are seen to be rounded but tapering somewhat at the ends. The tapering and relatively rigid point would possess the necessary piercing powers to produce the results observed.

In addition the filaments grew with surprising rapidity. The one illustrated was about four millimeters long at the time it was drawn but an hour later the two distal branches were more than twice the length from their junction that they were at the time of drawing. The estimated growth during the hour was nearly half a millimeter and, in fact, the increase in length was so rapid as observed under the microscope that one could see the difference from moment to moment. The rapid growth, then accounts for the relatively great length and numerous branches that were found distal to the points where the pierced animals were still struggling.

Perhaps this case may be cited as an example of maladaptation on the part of *Stylonichia vorax,* its feeding instincts having led it to attempt the impossible, namely, to swallow an unswallowable object; and furthermore an object which, by reason of its adhering to the animal's protoplasm, set up in the struggle to free itself reactions which resulted in forcing the rigid point of the object through its body, making it a prisoner.

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